To Advance Statewide GIS Coordination and Infrastructure

# Colorado GIS Coordination Strategic Plan

## DRAFT

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# Foreword

Colorado has a rich history in the development and use of Geographic Information Systems (GIS), with many independent initiatives over a period of more than 20 years. A grassroots effort to build a community of GIS professionals across public and private sectors has been underway for at least that long, embodied in the organization known as GIS Colorado. Nonetheless, it is generally recognized that additional coordination at the state level is needed. This **GIS Coordination Strategic Plan**, and the process that produced it, recognizes the fact that effective GIS Coordination in Colorado will require a very large number of stakeholders working in concert to support the vision and goals that have been formulated as part this Plan.

These stakeholders include federal, state, county, municipal and tribal agencies, as well as regional planning and non-profit organizations, utilities, academia, the private sector, and the public. Just as the federal government relies on individual states to participate in the national program, individual states must rely on their tribal, county and municipal counterparts to contribute to statewide programs. Whether responding to natural disasters such as blizzards and floods, or taking care of day-to-day operations such as public works and taxation, stakeholders need to work closely together to build effective statewide spatial data infrastructures (SSDI) that put spatial data into the hands of people who need it, when they need it, to help serve and protect our citizens.

Strategic planning is a critical element for articulating a shared vision, and for building the partnerships that are necessary for disparate organizations to work together on common goals. The key is to identify geospatial needs that are shared by many stakeholder groups. Effective strategic planning is essential for coalescing a community of stakeholders, moving collaborative programs forward and gaining the required support for investments in geospatial data and infrastructure in Colorado.

This strategic plan is written to guide statewide coordination activities for geospatial information technology in a systematic fashion. It identifies the components of a geospatial technology environment and architecture that most effectively serves stakeholders and consumers of geospatial technologies in the state. Potential specific collaborative or coordinated efforts can be defined and/or prioritized based on this plan. Accordingly, stakeholders in the geospatial community can use this plan to identify tasks that are deemed important to further geospatial technologies in the state. Additionally, the plan can serve as a set of benchmarks to measure progress in the geospatial information technology arena in the state. Last, this document will be presented to the executive leadership in the state to express the needs and goals for developing geospatial technologies to provide services and support governing and decision-making as effectively as possible.

The Appendices of this document contain information on the Strategic Planning Methodology that was applied to this project, including the names of the primary participants in the process. Also included is a list of key reference documents that were factored into the process.

## Acknowledgements

This project was supported by the Federal Geographic Data Committee (FGDC) as part of the Fifty States Initiative. This national initiative identifies implementation steps that should be undertaken to establish more formal statewide geospatial coordination that will contribute to completing the National Spatial Data Infrastructure (NSDI).

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# 1.0 EXECUTIVE SUMMARY

Overview

This GIS Coordination Strategic Plan is written to guide statewide GIS coordination activities in Colorado in a systematic fashion to benefit the people and institutions of Colorado, by seeking competitive advantage in support of Governor Ritter's "Colorado Promise". A series of GIS Stakeholder Workshops were held around the state as part of the planning process, including Grand Junction, Denver, Frisco, Durango, and Pueblo. Input from these workshops is factored into this plan, along with input from the state's Geospatial Coordinating Council and a GIS Strategic Plan Working Group, as directed by the State GIS Coordinator. The following Strategic Goals have been established:

| **Strategic Goal #1:** |
|---|
| Support better stewardship of our resources and increased prosperity, safety and services for our citizens by increasing GIS awareness and capacity across the state. |
| **Strategic Goal #2:** |
| Make government more efficient and effective through the coordinated use of geospatial technologies and the promotion of best practices. |
| **Strategic Goal #3:** |
| Enhance the information basis for public and private decisions by improving the quality and availability of geospatial information and services to support decision-makers and other consumers of GIS data and services, in concert with the state's enterprise architecture and the World Wide Web (www). |

Brief Background

Colorado has a rich history in Geographic Information Systems (GIS) and innovation in developing and applying geospatial technologies. On a per capita basis, it is reported that Colorado has a greater number of GIS professionals than any other state, and its GIS professional societies and GIS companies are thriving. Nonetheless, it lags behind other states in statewide coordination of GIS and geospatial data aggregation, warehousing, and dissemination. As a result, there are data gaps, duplication of effort, and lack of access to reliable data to support statewide initiatives.

The GIS Portal that was launched in late 2007 is a step in the right direction to help identify available geospatial data and resources. However, many states already have gone beyond simple portals and have implemented geospatial Data Warehouses and Web Services in support of statewide applications.

The Problem

State agencies generally pursue geospatial data development in an independent fashion, with very little cross-agency coordination on a formal, accountable basis. Agency perspectives are typically limited to the specific confines of the business needs and mission requirements of each department. Data deficits, duplication of effort, and under-utilized data assets and infrastructure persist due to this 'information silo' approach across the state as an enterprise.

Geospatial data sharing between state agencies is not mandatory, but does occur to varying degrees on a voluntary basis. Authoritative data sets and data stewards have not been officially established, putting the State of Colorado at a disadvantage compared to other states that have streamlined access to authoritative data. In a national GIS landscape where the visibility of such deficiencies is high, it is time for Colorado to act in a positive, proactive manner.

The Solution

Long-term, the state needs an enterprise architecture for sharing geospatial data. This will require alignment of GIS initiatives with Information Technology (IT) initiatives. In the short-term, the state needs to execute a clear mandate for GIS Coordination, build a Geospatial Data Warehouse for aggregating and sharing authoritative data, and integrate geospatial requirements into the state's IT planning and budgeting.

Better stewardship requires greater awareness of the dollars already spent on geospatial data, and improved infrastructure to use it. The state needs to establish unambiguous responsibility and accountability for producing and sharing authoritative geospatial data between state agencies, and between the state and local governments. This starts with establishing a definitive list of what data is most needed, and then making it accessible.

Key Recommendations

The following are specific recommendations that are explained in greater detail in the body of the plan document, along with the situation analysis and supporting rationale.

- Establish a position within the Governor's Office of Information Technology (OIT) for the role and responsibility of Statewide GIS Coordination
- Establish a formal mandate for Statewide GIS Coordination in an Executive Order from the Governor, including the following components:
    - Statewide GIS Coordinator
    - Statewide Geospatial Coordinating Council
    - State Agency Technical Advisory Committee
- Establish a Geospatial Data Warehouse for aggregating and sharing authoritative data sets
- Include geospatial data and technology requirements in OIT Enterprise Architecture planning and deployment

# 2.0 CURRENT SITUATION

There is a solid foundation to build on in Colorado when it comes to GIS. The state's experience and accomplishments in using GIS are praiseworthy, but the need for greater coordination and a statewide enterprise approach is evident to harness the full potential of the technology in support of Governor Ritter's "Colorado Promise." This section provides a context for the goals and requirements that are addressed in later sections of the plan.

## 2.1 Development of the GIS Strategic Plan

Plan Development and Coordination

The State GIS Coordinator led the development of this plan, with input from the state's GIS community of interest (COI). To facilitate outreach to this diverse COI, the Coordinator organized a Geospatial Coordinating Council. The Council is a volunteer, *ad hoc* body of stakeholders in the geospatial information arena including federal, state, and local government entities, private corporations, universities, and the general community of GIS users in the state. It is a multi-purpose group, formed to support coordination efforts and enhance the use of geospatial information and technologies to benefit all of the citizens of the State of Colorado. The members were invited to participate on the Council by the Coordinator and to provide input to this Plan.

The Council meets regularly, under the chairmanship of the Coordinator. Its considerable, combined experience in the geospatial arena has contributed to a strong conviction that a well-coordinated environment in the state will allow professionals utilizing geospatial technologies to spend their time applying these technologies to solving problems or supporting their business needs rather than searching for data or figuring out how to use it.

In addition to the Council, the State GIS Coordinator organized a Strategic Planning Working Group for the purpose of developing and reviewing content for this plan. This Working Group comprises individuals who responded to a "call for volunteers" that went out to the Colorado GIS user community. The members of both the Council and the Working Group are listed in Appendix A of this document.

An important part of the effort was a series of Stakeholder Workshops held in different parts of Colorado (i.e., Grand Junction, Denver, Frisco, Durango, and Pueblo), to gather input on GIS needs and priorities, particularly from the perspective of local authorities. These were also organized by the State GIS Coordinator. See Appendix A for a more complete description of the strategic planning methodology.

National Context

This project was funded in part by the Federal Geographic Data Committee (FGDC) as part of the Fifty States Initiative. This national initiative identifies implementation steps that will lead to more formal and effective statewide geospatial coordination including the formation of statewide coordination councils that will become stable partners in completing the National Spatial Data Infrastructure (NSDI). The NSDI was mandated by an Executive Order, originally issued by President Clinton (EO 12906) and subsequently amended by President Bush (EO 13286), to establish modern and effective data sharing to support national interests. The initiative has the following overarching goals:

- To encourage people to implement statewide spatial data infrastructures, that can eventually feed the NSDI, starting with effective strategic and business planning efforts.
- To encourage the formation of partnerships and alliances that will help in both the strategic and business planning process.
- To provide a uniform organizational framework for strategic and business plans, so that it is easier for organizations such as NSGIC and/or Federal agencies to compare and contrast different plans next to one another.

For more information on the NSDI, the reader should look at the FGDC web page at www.fgdc.gov.

In addition, the Western Governor's Association (WGA) unanimously adopted Policy Resolution 06-14 regarding the importance of the nation's geospatial infrastructure. The full text of this resolution is included in Appendix C of this plan.

## 2.2 Where are we now?

Geospatial Data Development and Sharing

Ten state agencies engage in mission-specific activity with geospatial technologies, along a broad spectrum of sophistication. Several other agencies have expressed a need for this technology as well. In addition, at least 43 out of the 64 counties and multiple cities and towns in the state utilize GIS in various forms. Colorado has a robust private sector industry related to geospatial technologies and has been represented as having the highest *per capita* concentration of GIS professionals in the country.

State agencies generally pursue geospatial data development in an independent fashion. Agency perspectives are typically limited to the specific confines of the business needs and mission requirements of each department. Data deficits, duplication of effort, and under-utilized data assets and infrastructure persist due to this 'information silo' approach across the state as an enterprise. Geospatial data sharing between state agencies is not mandatory, but does occur to varying degrees on a voluntary basis.

Local governments in Colorado develop a substantial amount of geospatial data. Sharing this between state and local authorities is done in an *ad hoc* fashion typified

by voluntary *quid pro quo* and limited participation and enthusiasm. An exception is local road data, which is supplied to the Colorado Department of Transportation (CDOT) in return for a share of federal highway funds that are disbursed by CDOT. CDOT then publishes local road data on its website, available to all parties. Additionally, authoritative datasets and data stewards have not been officially established for commonly required geospatial features, and *de facto* responsibility for maintaining and disseminating authoritative datasets is informal and inconsistent.

Generally, because replication of data from one department to another is lacking for the most part, individual departments and the State GIS Coordinator must actively seek out data from other departments when statewide coverage for multiple layers is needed to support their mission, as is the case with the Colorado Division of Emergency Management (CDEM) for the Multi-Agency Coordination Center (MACC). In some cases, Departments maintain their own repositories on a piecemeal basis. Maintenance of multiple redundant data stores is difficult, expensive and inefficient.

The state has implemented a GIS Portal [http://coloradogis.nsm.du.edu] with the intent to help GIS users discover and access available GIS datasets provided by portal participants. The portal is the first step towards establishing a single clearinghouse for geospatial data that will facilitate access to geospatial data for Coloradans, but participation has been low. In the current portal environment, state agencies and other data producers voluntarily provide the data they wish to share, if any, with no required resolution for redundancy and data conflicts across the set of data producers.

While some sharing of geospatial data does take place through the GIS Portal and elsewhere, there is no statewide policy regarding GIS data organization, steward assignment, and dissemination. Many stakeholders also warehouse and disseminate data via organization-specific mechanisms such as agency websites (e.g., CDOT).

Many states have gone beyond the GIS Portal stage, and have established GIS Clearinghouses. In general, a GIS Clearinghouse is a central operation for collecting, storing, and disseminating GIS resources -- particularly GIS data. The New York State GIS Clearinghouse, the Utah State Geographic Information Database (SGID), and the North Carolina “OneMap” are just a few of the existing examples of GIS Clearinghouses that seek to promote GIS data access and sharing through a centralized mechanism.

The State of Colorado is not a GIS leader in this regard, and the GIS Portal will not even achieve parity, although it is a step in the right direction. The main contrast is that in a GIS Portal, collective data resources are not physically centralized, but remain distributed across the stakeholder community where they are subject to individual data processing methods, standards, and distribution policies. Open sharing of data is entirely voluntary, and data stewardship is left entirely up to participants. There is little or no formal monitoring and administration, which may lead to an overabundance of redundant and poorly documented data, and many gaps in coverage and availability.

GIS Technology and Overall IT Direction

Current IT strategic direction, lead by Governor Ritter and State CIO Mike Locatis, is focused on a phased migration from a decentralized model of IT services to a more proactively managed and consolidated structure. A recent study found 38 Data Centers in 23 Departments across the state, with poor utilization of server and storage infrastructure; poor HVAC and energy control; lack of fire suppression; lack of redundant power supply or energy backup; and inadequate security.

It is estimated that as much as 90-95% of all GIS software in Colorado is purchased from ESRI of Redlands, California. Recently, a Master Purchasing Agreement (MPA) was negotiated with ESRI for state agencies and other government to secure better and more consistent pricing. Vendor diversification in GIS is not necessarily a current policy objective in the government sector in Colorado, although the State CIO is interested in potential cost savings from utilizing open source or other application solutions where feasible.

GIS technology selection is typically not driven by business need, which can be problematic. Reportedly, there are many instances where even the simplest ESRI product provides far more functionality than required by specific business needs, such as well permitting. Alternatives to ESRI include other proprietary products as well as open source code, but it is less clear what share of the market these command in Colorado, although it seems to be growing. Recent market trends indicate that products from Google, Microsoft, and the Open Source community can complement ESRI technology in enterprise approaches to delivering geospatial data or services.

Funding streams for GIS technology exist mostly at the Department or Program level. Decentralized funding has resulted in a proliferation of over 100 ESRI customer-numbers within the state, although some agencies have recently worked to consolidate the proliferation of separate customer accounts within their agency. The result is unnecessary administrative overhead, an excessive number of licenses, and lost opportunities to decrease both annual maintenance costs and the total cost of software ownership by pooling, sharing, and maximizing the total use of these resources on a statewide basis.

There is no enterprise architecture for sharing geospatial data in Colorado, and cooperation with the State GIS Coordinator is strictly voluntary. There is no clear charter, authority, or Memos of Understanding (MOUs) to assure cooperation across state departments or levels of government to achieve data sharing objectives.

Resources and Staffing

Currently, the State GIS Coordinator position is located in the Department of Local Affairs (DOLA), and it includes duties in support of the Division of Emergency Management (CDEM). CDEM is responsible for the state's Multi-Agency Coordination Center (MACC), to support emergency management statewide, including liaison with local authorities. The MACC has limited GIS capabilities to

support its emergency management functions, let alone statewide GIS coordination, although the two are clearly related in terms of identifying and accessing reliable authoritative datasets on a statewide, sustainable basis. In the short-term, with the upcoming Democratic National Convention (DNC) scheduled to occur in Denver this summer, the emergency management part of the State GIS Coordinator's role has added importance.

There is no officially chartered governance model for GIS coordination in the State of Colorado at the current time. Recently, the State GIS Coordinator organized an ad hoc Colorado Geospatial Coordinating Council. The Council membership is by invitation, and participation is subject to the support of members' parent organizations and supervisors. Without official recognition and a charter, the Council's coordination activities may not be sustainable.

Many agencies have established GIS programs to support their departmental missions, including Local Affairs, Transportation, Health and Environment, and Natural Resources. Other agencies lack dedicated programs but may have some GIS capability. Examples include Agriculture, Corrections, Education, and Public Safety. Still other agencies, such as Department of Revenue and Secretary of State, lack GIS capacity but have interest in geospatial technologies or applications and might be future consumers of enterprise services.

Currently, important enterprise-level functions related to business needs, data integration, and applications are not assigned to any particular department or personnel that can be held accountable for meeting goals. The State GIS Coordinator is the only person with titular responsibility for addressing some of the goals, and yet, he is expected to perform departmental duties in addition to cross-departmental and cross-sector coordination, without any staff. As a result, enterprise-wide capabilities are slow to get started and not developed to their full potential effectiveness. This needs executive attention for expectations to be sensibly calibrated with the availability of resources.

Unlike a number of states around the country, Colorado does not have a formal, centralized GIS program to provide statewide enterprise GIS services and an authoritative data repository, and, as in most states, funding or obtaining approval from the state legislature for new positions (FTEs) is always difficult, whether for GIS or other needs. In addition, the statutory environment in Colorado presents some severe financial constraints. Most notable is the "Tax Payer Bill of Rights," which restricts potential growth in the state budget and the ability of state government to levy new taxes.

## 2.3 Strengths and Weaknesses

The State of Colorado needs to build on recognized strengths, and remedy identified weaknesses, in order to advance and benefit from GIS coordination. The strengths and weaknesses listed in this section were compiled based on input from the GIS Coordination Strategic Plan Working Group and the Geospatial Coordinating Council, as well as input from Stakeholder Outreach Sessions that were conducted in:

Grand Junction on the Western Slope in October 2007; Denver on the Front Range in November 2007; Frisco in Summit County, and Durango in La Plata County, both in December 2007; and Pueblo in January 2008.

### 2.3.1 Strengths

Grassroots activity and interest in GIS is high amongst GIS professionals in Colorado, and all levels of government have been active for many years in applying GIS. There is high-level support amongst current executive leadership. The strengths articulated by stakeholders during the strategic planning process fall under these two headings: 1) Broad activity & interest; and, 2) High-level support & recognition.

| STRENGTHS |
|---|
| ***1) Broad activity & interest*** |
| a) Colorado is home to a large, vibrant GIS community with strong government programs at all levels and top vendors and consultants<br>b) There is an effective, grassroots GIS association (GIS Colorado) with a 20 year history of encouraging the exchange of ideas and data<br>c) Existing local partnerships and cooperative ventures offer exemplars for statewide efforts as do successful grant recipients for GIS development<br>d) The state has made progress on the "Nine Criteria" for a successful statewide GIS program as defined by The Federal Geographic Data Committee (FGDC) and the National States Geographic Information Council (NSGIC) as part of the "Fifty States Initiative" to strengthen the National Spatial Data Infrastructure (NSDI), including a State GIS Coordinator<br>e) Federal land management agencies with responsibilities in Colorado have longstanding and proactive GIS programs<br>f) Geospatial training and educational courses available through Colorado's colleges and universities provides the state and its citizens with strong educational resources, and Denver is a nationally recognized center for Geo-tech training |
| ***2) High-level support & recognition*** |
| a) Governor Ritter is aware of the benefits of geospatial technologies to the State of Colorado and the 'Colorado Promise'<br>b) The State Chief Information Officer (CIO), Mike Locatis, recognizes the importance of GIS as part of the state's Information Technology (IT) infrastructure<br>c) The Western Governors Association (WGA), which includes Colorado, unanimously adopted Policy Resolution 06-14 regarding the importance of Geospatial Data and GIS as part of the nation's infrastructure (see Appendix C) |

### 2.3.2 Weaknesses

The Stakeholder Outreach Sessions, Council Meetings, and Working Group discussions identified many weaknesses that can be grouped into three main areas of deficiency: 1) Lack of awareness & capacity; 2) Lack of officially acknowledged GIS governance, best practices, & policies; and, 3) Lack of reliable data & suitable architecture for sharing data & services.

| WEAKNESSES |
|---|
| ***1) Lack of awareness & capacity*** |
| a) Lack of widespread awareness of the value of GIS amongst state and local decision-makers and other potential "consumers" of GIS data and services (e.g., school districts)<br>b) Some local communities have resources to take advantage of GIS, but some do not (i.e. the "haves" and "have nots")<br>**c)** Lack of concentrated resources at the state level to improve GIS capacity and coordination, including a lack of funding |
| ***2) Lack of officially acknowledged GIS governance, best practices, & policies*** |
| a) Lack of clear and accepted data stewardship responsibilities for authoritative data layers amongst data "producers" and data "aggregators"<br>b) Lack of execution of authority at the state level to set GIS policies and standards for State Agencies<br>c) The absence of "cooperation and collaboration" in mission statements for State Agencies<br>d) Lack of incentives for State⇔Local cooperation and coordination on data sharing<br>e) Lack of history or pattern of data exchange and collaboration between State Agencies and local governments, with some notable exceptions (such as CDOT)<br>f) Data deficiencies and duplication of effort due to a combination of weaknesses identified herein<br>g) Frictionless data sharing and dissemination is inhibited by the Colorado Open Records Act (CORA), which allows custodians of geospatial data to charge requestors some portion of the cost of developing and maintaining the data, amounting to significantly more than the cost of duplication, which reduces demand and utilization of the data<br>h) Data sharing is inhibited in cases where communities obtain data provided by private/commercial data producers, without obtaining the rights to distribute such data -- such data providers are sometimes reluctant to "sell" data to all requestors, thereby preserving competitive advantage and further inhibiting data sharing |
| ***3) Lack of reliable data & suitable architecture for sharing data & services*** |
| a) Lack of modern, statewide enterprise architecture to support sustainable data sharing between state and local government and private entities on a broad, |

consistent basis

b) Inadequate archival and preservation of historic records, and lack of access to such records -- such data might relate to old property transactions or mining claims, and could become relevant in current and future contexts

## 2.4 Opportunities and Threats

Better coordination of GIS utilization can be a strong contributing factor in the successful pursuit the Colorado Promise. The strengths and weaknesses listed previously, as well as external factors in the economy and GIS community at-large, yield the set of opportunities and threats that are described, below.

### 2.4.1 Opportunities

It is encouraging to see the number of opportunities that were identified by stakeholders during the strategic planning process. They cluster into two broad types: 1) Leadership; and, 2) Approaches.

| OPPORTUNITIES |
|---|
| ***1) Leadership*** |
| a) Given Governor Ritter's awareness of GIS, pursue executive level support to address current weaknesses and apply GIS to the "Colorado Promise" |
| b) Leverage both IT infrastructure improvements and the state's emerging enterprise architecture with State CIO support for GIS data sharing and services |
| c) Enlist GIS Coordinating Council members to help in their domain areas to promote data sharing and the programs necessary to achieve it; establish responsibilities for engaging their counterparts in proactive GIS Coordination, and lobbying for support where appropriate |
| d) Foster growth in the geospatial industry in Colorado to strengthen the economy |
| e) Colorado's leadership in Geo-tech training programs is an advantage to politicians and government officials interested in economic growth and fostering national primacy for Colorado in geospatial technologies -- this is an opportunity in a global economy where competitive advantage is hard to earn and easy to lose |
| ***2) Approaches*** |
| a) Increase participation in data sharing and the development and awareness of GIS resources amongst both data producers and consumers with the new GIS Portal (http://coloradogis.nsm.du.edu) |
| b) Achieve economies-of-scale in purchasing and contracting with stronger GIS coordination infrastructure and procedures |
| c) Learn from other states who have established effective State⇔Local coordination and collaboration |

d) Use GIS for post-event analysis, to assist with damage mitigation, and to enhance preparedness for future events

e) Area integrators (and/or aggregators) could play a role in compiling consistent data resources for their areas -- data models need to be shared, to help in this regard

f) Understand what private data suppliers may offer; in the current geospatial industry environment, private companies sometimes engage in data collection to fulfill a need in the marketplace, while typically holding the rights to the data and providing it to consumers for a license or subscription fee; and, some of these companies are located in Colorado

g) Pursue grants from federal programs and other sources, such as the National Association of Counties (NACO), that encourage geospatial coordination and infrastructure development

h) Develop best practices for "have-nots" and a clearinghouse for tools and resources

### 2.4.2 Threats

In the face of very real threats that confront the State of Colorado, there is no better time than now to accelerate and improve the adoption of geospatial technologies. The threats identified during the strategic planning process breakdown into two categories: 1) Poor decisions & inadequate preparedness; and, 2) Liability & loss.

| THREATS |
|---|
| ***1) Poor decisions & inadequate preparedness*** |
| a) The state's readiness for assisting during natural and manmade disasters is less than what it should be given the lack of current, accurate local data on a sustainable basis, and no 'Common Operating Picture' |
| b) State and local authorities may make poor decisions with regard to growth management, resources, and services when made without the support of better information provided by GIS |
| ***2) Liability & loss*** |
| a) The inefficient use of government resources due to duplication of effort and lack of adequate infrastructure might be construed as a violation of the public trust |
| b) The specter of lawsuits for mishaps potentially caused by inaccurate geospatial data or inappropriate applications raises the fear, uncertainty and doubt about sharing data when liability, indemnification, and disclaimers are not clearly understood |
| c) Sensitive data getting into the wrong hands due to lack of adequate data classification and security is a potential risk to unfettered data sharing |

d) Lack of back-up storage sites and procedures could threaten geospatial data assets in the event of an emergency -- in this context, Geographic Information Systems become part of the state's critical infrastructure, and plans are needed for Continuity of Operations (COOP)

e) There is a potential for the state's Geospatial Coordinating Council and GIS coordination efforts to be marginalized unless benefits are demonstrated to the GIS community and executive champions, such as the State CIO

f) Elements of the geospatial industry in Colorado may be lost from a lack of coordinated support from the state

# 3.0 VISION AND GOALS

A key component of the GIS Coordination Strategic Plan is the expression of a vision and corresponding goals to move forward the state's good intentions into concerted actions. The expression of these in a formal and actionable way is the purpose of the following sections.

## 3.1 Vision

Almost all government and private activities depend on reliable information about where things are located. For example, geospatial technologies are instrumental in achieving the objectives of Governor Ritter's "Colorado Promise," whether that entails planning for schools, improving access to health care, developing effective transportation systems, planning for and responding to natural and manmade disasters, protecting the quality and quantity of our water supplies, or promoting renewable energy development in the state.

Recently, geospatial technologies (e.g., global positioning systems, aerial imagery and remote sensing, and geographic information systems), and traditional information technologies, such as internet/intranet technologies, have been converging into powerful business platforms that can transform and improve business processes in both the public and private sectors. Today's challenge is to effectively leverage investments in these technologies, maximize their value in our current business processes and assure that these investments propel sustainable products and processes into the future. Effective coordination of geospatial activities among all levels of government and public and private sectors can meet this challenge.

## 3.2 Goals

The primary strategic goals for GIS Coordination in the State of Colorado, and the corresponding programmatic goals and success factors for action are included below. The success factors will be the basis for business planning and performance metrics,

for detailing and monitoring task-level implementation steps, which are outside the scope of the strategic plan.

These goals will be pursued within the framework of and will be congruent with the state's Strategic Information Technology (IT) Plan, from which the following guiding principles are derived:

- Secure and protect IT assets
- Optimize spending for IT decisions, projects and technology
- Effectively manage IT projects
- Improve enterprise service delivery
- Improve collaboration and innovation

**Strategic Goal #1**: Support better stewardship of our resources and increased prosperity, safety and services for our citizens by increasing GIS awareness and capacity across the state.

Rationale

The ability of local and state entities to utilize geospatial technologies for better stewardship of resources and enhancing the health and safety of Coloradans varies broadly across the state and within state government. Growing capacity in areas or agencies of the state that have limited or non-existent capability will benefit the entire state. By promoting the availability of geospatial information across the entire state, entities that are currently struggling will have greater awareness of resources that can enhance their effectiveness. Broader geospatial capabilities will provide greater opportunities for collaboration thereby increasing potential economies in application and data deployment.

| ***Strategic Goal #1*: *Support better stewardship of our resources and increased prosperity, safety and services for our citizens by increasing GIS awareness and capacity across the state*** | |
|---|---|
| **Programmatic Goals** | **Success Factors** |
| 1) Increase geospatial capacity across the state | a) Make planned investments in GIS data and infrastructure |
| | b) Provide programs to support GIS "have-nots" with access to data and services that could provide basic functionality for commonly needed capabilities, such as geocoding addresses for locating on a map; another example could be to provide access to people expertise (e.g., a GIS "Circuit Rider" who makes the rounds) |

| | |
|---|---|
| 2) Improve and expand communications, awareness, and knowledge about GIS across the state | a) Communicate with the community-at-large, such as decision-makers or policy-makers, and educate about the benefits and capabilities of GIS, and the advantages to be gained for Colorado through GIS coordination and data sharing |
| | b) Increase the community's knowledge about the use and application of geospatial technologies by making success stories and case studies on lessons-learned available to non-GIS professionals |
| | c) Provide briefings to executive leadership in the current administration on GIS coordination initiatives and benefits |
| | d) Increase awareness of duplication of effort in geospatial technology and data development and highlight improvements from coordination and reducing such duplication |
| | e) Promote the adoption of sensible standards that will facilitate data sharing and collaboration |
| | f) Increase the use and support of the State's GIS Portal [http://coloradogis.nsm.du.edu] |
| 3) Strengthen geospatial applications across the state | a) Enhance post-event damage assessment and mitigation through expanded use of GIS |
| | b) Enhance applications of GIS to the five priorities of the Colorado Promise (Education, Health Care, Economy, Renewable Energy, Clean Water For All), as well as Critical Infrastructure, Public Safety, and Resource Protection |

**Strategic Goal #2:** Make government more efficient and effective through the coordinated use of geospatial technologies and the promotion of best practices.

Rationale

Data useful for one entity is often maintained by another public or private entity. Obstacles to the exchange of this data should be addressed to improve the application of geospatial technologies to business needs across the state. Clearly, more facile

exchange of geospatial information will improve collaboration, service delivery and will promote more effective project implementation.

Standards and common data management, collection and analysis practices provide more interoperability of data and systems, thereby expediting collaboration and information sharing. These methods and approaches will increase the probability that multiple entities can participate in and benefit from geospatial development efforts. Best practices promoted through a state organization, such as the coordinating council, can also guide and assist entities striving to overcome the large barriers to entry for geospatial technologies.

In addition, the potential for collaboration in data and application development is often stymied by restrictions in public agencies' ability to accept grants and other funds and inefficiencies in procuring goods and services. There is a need for facilitating procurement of geospatial data and services, as well as standard methodology and best practices for data collection and management.

| ***Strategic Goal #2:*** *Make government more efficient and effective through the coordinated use of geospatial technologies and the promotion of best practices* | |
|---|---|
| **Programmatic Goals** | **Success Factors** |
| 1) Provide guidance on best practices to GIS practitioners at all levels across the state | a) Sponsor and promote sensible standards for data development, management and exchange |
| | b) Sponsor and promote sensible data classification for geospatial data to assure the protection of sensitive data without inhibiting appropriate sharing of non-sensitive data |
| | c) Sponsor and promote practical data models to facilitate data sharing and aggregation |
| | d) Provide guidance and a Frequently Asked Questions (FAQ) sheet on CORA as it pertains to GIS data |
| | e) Provide guidance on best practices for all aspects of running a GIS, including software, hardware, applications, and staffing requirements, as well as data aspects |
| 2) Establish formal governance for GIS coordination to establish greater accountability for achieving statewide objectives | a) Improve the organizational structure and ability to accept, leverage and spend dollars |
| | b) Establish clear and accepted responsibility for authoritative sources of geospatial data |

| | |
|---|---|
| | c) Establish a position with authority for GIS coordination, to negotiate agreements, delegate responsibilities and be an authorized voice for GIS in Colorado |
| | d) Establish a formal charter for the Geospatial Coordinating Council |
| 3) Promote frictionless sharing and exchange of geospatial data and collaboration among governmental levels and the public and private sectors | a) Implement policies and measures to remove, mitigate or overcome barriers to geospatial data sharing and to expedite data sharing and collaboration across the state to strengthen GIS infrastructure and interoperability |
| | b) Develop in-state grant programs to make data sharing attractive through financial incentives |
| | c) Promote more coordinated and consolidated exchanges of data between jurisdictional levels to make data sharing more efficient |
| 4) Promote an enterprise architecture approach to geospatial investments and developments that is integrated into the enterprise architecture for IT across the state | a) Identify state organizational needs for geospatial technologies and the commonalities of these needs across state agencies |
| | b) Provide guidance on specifications for needed geospatial technologies to both OIT and departments with GIS programs |
| | c) Promote a state organizational structure that can support enterprise-wide provision of geospatial services and data and an enterprise approach to data sharing |

**Strategic Goal #3:** Enhance the information basis for public and private decisions by improving the quality and availability of geospatial information to support decision-makers and other consumers of GIS data and services, in concert with the state's enterprise architecture and the World Wide Web (www).

Rationale

A significant obstacle in utilizing geospatial technologies is finding and acquiring data appropriate for a specific task. More available and accessible information will improve the overall delivery of services across the state enterprise and help optimize spending as well as allowing scientists and subject matter experts to focus on their

jobs and supporting decisions or policy-making. Geospatial assets must also be protected while enhancing access to information.

| ***Strategic Goal #3:*** *Enhance the information basis for public and private decisions by improving the quality and availability of geospatial information and services to support decision-makers and other consumers of GIS data and services, in concert with the state's enterprise architecture and the World Wide Web (www)* | |
|---|---|
| **Programmatic Goals** | **Success Factors** |
| 1) Establish a repository of statewide geospatial data sets from authoritative sources for prioritized features and data types | a) Compile a core set of statewide data sets from authoritative sources – the following types of data are considered priorities based on input from the strategic planning process: Parcels, Roads, Hydrography, Ortho-imagery, Land Cover, Elevation, and Administrative Boundaries |
| | b) Establish repeatable update and maintenance procedures |
| | c) Investigate the availability and economic attractiveness of private sector sources for high-demand data sets |
| 2) Provide easy and ubiquitous access to both geospatial data and metadata for both professionals and citizens | a) Improve access to and availability to authoritative geospatial information, in consideration of sensible system and data security measures |
| | b) Make authoritative data available through common protocols and *defacto* standards that will enable sharing across all branches and levels of state and local government (e.g., shape files, XML, and KML or KMZ files) |
| | c) Think beyond state-owned systems, and enable the citizens of Colorado to access and use authoritative GIS data and services via the Internet |
| 3) Recognize GIS as critical infrastructure and enable a Web service-orientation for basic GIS functions to meet statewide demand | a) Ensure the back-up and survivability of GIS data and systems as an integral part of critical infrastructure protection |
| | b) Make high-demand GIS functions, such as geocoding, available as Web services that can be invoked by a variety of client applications |

# 4.0 REQUIREMENTS

Colorado has articulated a forward-looking GIS vision statement with both strategic and programmatic goals as stated in the prior section. The following sections evaluate the elements key to the success of these goals, building on the studies performed independently in 2007 by CH2MHill and Applied Geographics, Inc. (See Appendix B for document references.)

## 4.1 Geospatial Infrastructure Requirements

The requirements in this section are summarized in terms of data, technology, resources, and standards. Related content and supporting details are available in the studies cited in Appendix B, as well as in the other sections of this plan document.

### 4.1.1 Data Requirements

Data as a Resource

Geospatial data should be considered a resource. Coloradans have made considerable investments in such data, across all levels of government. No one knows with any certainty how many dollars have been invested overall, nor how many dollars are required to keep existing data current and to eliminate data gaps. However, it is known that there is considerable duplication of effort and underutilization of existing data as a managed asset.

Better stewardship requires greater awareness of the dollars already spent on geospatial data, and improved infrastructure to use it. The state's GIS Portal is a step in the right direction, but to develop a culture of proactive data sharing, stronger support is needed. Executive leadership within the state needs to endorse and promote the use of the GIS Portal. For example, data producers need to publish metadata about existing geospatial data, if not the data itself. If they do not make potential data consumers aware of what exists, demand will not be met, and duplication of effort and underutilized assets will persist.

Developing and Sharing Authoritative Data

The state needs to establish unambiguous responsibility and accountability for producing and sharing authoritative geospatial data between state agencies, and between the state and local governments. This starts with establishing a definitive list of what data is most needed, and then making the data accessible.

Input from the GIS Stakeholder Workshops held around the state, and subsequent discussions with Council members and the Working Group, yielded the following list: Land Parcels, Roads, Hydrography, Ortho-imagery, Land Cover, Elevation, and Administrative Boundaries. These layers are needed by all sectors, and some are primarily developed at the local level (e.g., parcels), while others are developed at the

state level (e.g., roads). In addition to geometry associated with these layers, there are descriptive attributes, such as address and ownership information about land parcels, and linear referencing information about road segments, for example.

A specific recommendation emerged from the strategic planning process to implement in-state grant programs to make data sharing more attractive, by using grants as financial incentives. The specific case was made in the context of land parcel data, where there are revenue interests at both the state and local level in property. A requirement for grant eligibility could be delivering data in a standard format or data model that is specified with practicality and simplicity in mind. Clearly, the political and fiscal environment in the state would have to change to support such a program.

Data Warehouse and Portal

Once the authoritative sources are established for prioritized features and data types, a repository of such data is needed to support statewide enterprise objectives. In many states, the term 'GIS Clearinghouse' has been used to describe their centralized data repositories, but as GIS comes into greater alignment with IT, the term 'Data Warehouse' is gaining favor. The data is likely to come from multiple sources, including state, local, and private sectors, where it may be managed in transactional environments.

The statewide repository of data could be developed in conjunction with the GIS Portal, and could link to federated databases as well as serve as a consolidated resource. An added benefit of a repository for authoritative data is the backup it represents for ensuring data survivability. In contrast to only a Portal, the Data Warehouse would establish direct access to at least a modicum of authoritative geospatial data for GIS stakeholders, with a responsible amount of quality control. Participation in the warehouse would be collaborative, but there would be central administration to provide oversight, data quality control, and data security, as necessary. The mechanisms to achieve this vary, but usually entail some degree of formalized and/or implicit data sharing agreements with defined data stewardship, standardized GIS content managed by a technical database administrator, and ideally some data quality feedback mechanism where user enhancements are captured and incorporated into the authoritative data where appropriate.

The initial priority should be on making data available to those who need it, by establishing a GIS Data Warehouse. Longer-term, this can evolve to become the nucleus for Web services (which are discussed more under 'technology requirements', later in this section). A simple way to make data available is to publish it in popular formats that are widely used, such as SHP, XML, KML, and/or KMZ files. (See "Conceptual Diagram for a GIS Data Warehouse", later in this section.)

The development of a GIS Data Warehouse is a substantial undertaking, which requires long-term support and cooperation. Myriad technical, political, organizational and financial obstacles must be overcome, particularly when it comes

to integrating local contributions. The challenge is illustrated by the following technical issues:

- Inconsistent data models across jurisdictions with regards to structure, topology, content, relationships, classification systems and domains
- Lack of data connectivity at the borders
- Difficulty getting adjacent jurisdictions to agree on exact locations of connections for trans-border features (as well as actual border delineations)
- Technical approaches to keep datasets that are transactionally-maintained up-to-date or to create user-friendly, transparent interfaces to federated collections are needed, long-term
- Time and cooperation required to develop common data models is sometimes greater than data exchange between well-documented models
- Varying levels of positional and attribute accuracy, currency and completeness make quality assurance important
- Different "world views" of basic elements (e.g., is a bridge a point, a line, or an area?) depend on the scale of your database

These and related technical issues will not be resolved quickly. Extraction, Transformation, and Loading (ETL) is a handy short-term approach, but is challenging when original data sets are updated frequently based on daily transactions. Quality assurance is needed as part of ETL processes, to determine if there has been data loss, with appropriate validation and restoration steps as needed. This becomes easier as the same ETL process is repeated and refined on an an ongoing basis. In the longer-term, a federated data warehouse approach and more extensive Web services should be increasingly feasible, partly as a function of improvements in the state's IT infrastructure, as well as advances in geospatial technology and service-oriented architecture.

### 4.1.2 Technology Requirements

Technical Capacity

One of the findings from the Stakeholder Workshops is the need for GIS capacity to take care of demand at the local level, where the use of GIS can enhance local stewardship of resources and infrastructure. While some municipalities have adequate capacity, many do not. Those who do not would like to have access to GIS data and basic functionality, in support of local needs such as public safety, economic development, community planning, and natural resource management.

While access to data would be helpful in its own right, access to services that can apply the data is of equal interest. For example, a geocoding service to match addresses to geographic locations is of general interest. A service-orientation to the state's plans for enterprise architecture should be fundamental, and should include access to both GIS data and functionality.

Enterprise Architecture

The state's plans for enterprise architecture need to include support for GIS data and services. GIS data places specific demands on IT systems to support large volumes of storage, and GIS analytical functions require robust processing and memory capabilities. The enterprise architecture should consider means for delivering services to state agencies and local entities in a robust, scaleable and efficient manner. A Service-Oriented Architecture (SOA) is the recommended design pattern, to enable business processes to take advantage of geospatial data and Web services.

To some industry experts, an enterprise approach to data development and stewardship implies a unified data model that can support multiple agency needs; but there are many examples across the GIS industry where enterprise efforts have been bogged down due to excessive data modeling, without adequate regard to actual data availability and business needs. While it is not practical to develop one data model that can support every application of the potential users of geospatial data, it may be possible to establish a simplified data model to satisfy needs that are repeated among several agencies.

For general-purpose applications and most business needs, simple data models are preferred. The more complicated the model, the more difficult the associated Extraction, Transformation, and Loading (ETL) processes become to get data in or out of the model. This was a clear lesson-learned within Colorado at the Multi-Agency Coordination Center (MACC) as part of Project Homeland. Nonetheless, as GIS applications mature, attention is needed on data models that can support more sophisticated application requirements, driven by specific needs and business processes.

Consumer and Business Applications

It is opportune to take advantage of the growing pervasiveness and functionality of the Internet and the World Wide Web (www) as part of the technology environment available to Coloradans. In a GIS context, this is sometimes referred to as the GeoWeb, and it already includes a wide variety of citizen-oriented services, including driving directions, interactive trail maps, and GPS treasure hunting known as "geocaching."

The state should leverage these developments in innovative and practical ways, in support of business needs, and service to the citizens of Colorado. Applications might include on-line browser-based services, such as: locating the closest health care providers; registering at risk populations for evacuation planning; applying for building permits; well permitting; and other applications pertaining to land, resources, and people.

Colorado should expand the use and roles of GIS within agencies and throughout the GIS stakeholder constituency through strategic development of effective applications that address key policy issues.

### 4.1.3 Resource and Staffing Requirements

Level of Effort

A substantial effort is necessary to tackle all of the actionable items identified in this plan. It will require a team of dedicated personnel and strong executive leadership. The funding for such a team does not currently exist, and is not likely to be made available in the short-term. A multi-year managed budget is needed, and support from existing departments where appropriate.

There is potential to increase existing staff capabilities through a mix of training, technical support, and custom application/task automation. Also, job descriptions should be formalized and standardized according to Agency need and circumstance, to attract skilled GIS technology professionals. Partnering with local educational organizations to address unmet needs for GIS education and to tap nascent GIS talent should be encouraged.

At a minimum, the State should establish GIS Database Administrator and GIS Technical Analyst(s) positions to support the State GIS Coordinator. This core group of personnel should be positioned to serve the needs of the GIS enterprise. In addition, the state should establish a GIS Technical Advisory Committee made-up of departmental representatives.

Roles and Responsibilities

Both intra-and inter-agency roles and responsibilities for GIS administration need to be defined. Also, a political champion for GIS and high-level Departmental staff that are agency GIS stewards are needed. Both can help to promote GIS awareness and capacity.

It is a disadvantage for the State GIS Coordinator position to exist at the Department level, with respect to enterprise-level coordination and guidance for state agency activities. Such coordination and guidance would be more appropriately be placed within the Office of Information Technology (OIT), under the direction of the state's CIO. As is occurring in other states, this position could be reoriented to be more of a Geospatial Information Officer (GIO).

Coordination with local stakeholders is also an important requirement, especially if harvesting local data and providing services to local "have-nots" is considered important. Reconciliation of these objectives – coordination across state agencies, and coordination between state agencies and local authorities – needs executive attention.

### 4.1.4 Standards

Best Practices

GIS includes data, software, hardware, processes, and people. Best practices for all of these aspects are needed. Establishing and promoting GIS best practices for automation, documentation, and other GIS activities will reduce the learning curve for State GIS users and make GIS a more accessible and affordable technology.

Promotion of standards for cartography, symbology, map templates and keys will help to "brand" Colorado GIS resources and promote their use through a familiar "look and feel."

GIS Standards

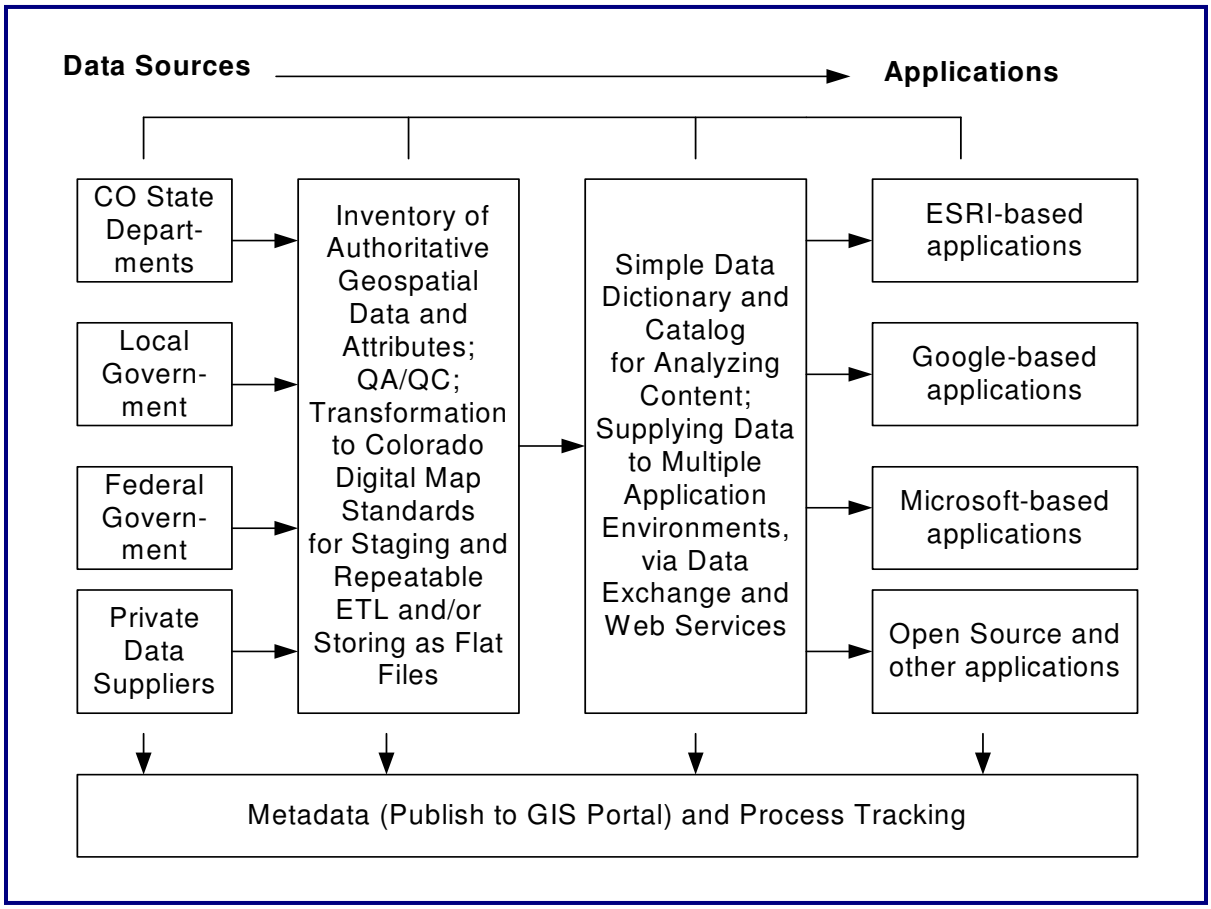
The most widely adopted technology tends to become the *de facto* standard as consolidation and centralization efforts take shape. GIS may be less subject to service disruptions if the majority of the GIS technology implementation is ESRI or ESRI-compliant, since knowledge and people are more easily transferable when the same products are being used.

Colorado's GIS effort may become constrained if the state is entirely reliant on ESRI technologies, when compared to the pace of innovation and rate of adoption of new alternatives. Long-term, an architecture that supports the option of vendor diversification is preferable for flexibility and negotiating leverage.

While not an absolute requirement in all cases, standardizing software, data, and metadata will unify the State's GIS resources and will facilitate application of data dissemination technologies such as portals and web applications.

The State GIS Portal provides for the standardization compliant with FGDC metadata standards. This standardization facilitates data searching but may be an obstacle to Portal participation if potential content providers cannot surmount the FGDC metadata learning curve.

Conceptual Diagram for a GIS Data Warehouse




## 4.2 Organizational Needs

In the State of Colorado, the organizational needs for geospatial coordination are complex, but no more so than in most other states. In fact, Colorado can take advantage of both lessons-learned and exemplars from other states, and adapt what might work in Colorado.

### 4.2.1 Executive Support

There is an overarching need for a clear charter that defines an organizational approach. This charter should come from the Governor in the form of an Executive Order, or potentially from the legislature, since it has bearing on the entire state. Many other states have followed this model, such as the neighboring state of Wyoming. A Working Group was set-up by the current Geospatial Coordinating Council members to draft suggested language for an Executive Order.

In addition, alignment of GIS Coordination with IT Coordination is needed, and this requires the support of executive leadership in both OIT and the departments with existing GIS programs. The State CIO has demonstrated his support, and has been a

participant in Geospatial Coordinating Council meetings. It is expected that GIS coordination duties will be transferred to OIT, under the leadership of the CIO.

### 4.2.2 Coordination and Oversight Procedures

There exists an opportunity in Colorado to strengthen its use of GIS to improve support for the 'Colorado Promise' and related statewide initiatives. A balance is needed between coordination efforts and the autonomy needed by state agency stakeholders, as well as the needs of the broader GIS community, statewide. Currently, Colorado lags behind other states in the formalization of GIS coordination and oversight procedures.

While coordination efforts and state agency independence needs to be balanced, effective coordination requires explicit and clear delegation of authority for coordination and inculcating cooperation. This can include establishing a position of Geospatial Information Officer (or equivalent to GIO, if a different title is used) within the Office of Information Technology (OIT) with the role of GIS Coordination as well as executive orders formally chartering the statewide Geospatial Coordinating Council (GCC), and a proposed GIS Technical Advisory Committee (GTAC) made up of representatives from state agencies who are stakeholders in geospatial technology infrastructure.

A Statewide Geospatial Coordinating Council (GCC)

The current GCC does not have an official charter or bylaws. A subset of current members has formed a Working Group to draft a charter to formalize the Council's purpose and structure. The GCC is envisioned as an advisory body to the Governor's Office of Information Technology, making recommendations on geospatial issues, policies, and programs. It would seek participation from a cross-section of agencies and sectors, with members selected from their respective communities and approved by the Governor's Office.

Membership is proposed to include twenty-seven (27) representatives (reps), including the CIO or his designee as the chairperson. Other members would include six (6) Executive Directors of State Agencies (or their designees); the state's National Geodetic Advisor; three (3) federal reps, including the state's USGS liaison and a rep from the US Census Bureau; three (3) municipal reps, including one from the Colorado Municipal League; three (3) county reps, including one from Colorado Counties, Inc.; four (4) private sector reps, including one from a utility company; two (2) reps from professional GIS organizations; two (2) reps from higher education; one (1) rep from a Council of Governments; and one (1) rep from a special district.

Alternatively, the GCC could be organized along geographical lines, similar to the Inter-Basin Compact Committee (IBCC). The IBCC is mentioned in this context for a couple of reasons. First, it exists as a tangible model – it is not an abstraction, and it is native to Colorado. Second, it has a local component comprising nine (9) regional roundtables – one for each of the river basins in Colorado, plus one for the Denver metropolitan area. Each roundtable has a liaison representative to the Colorado

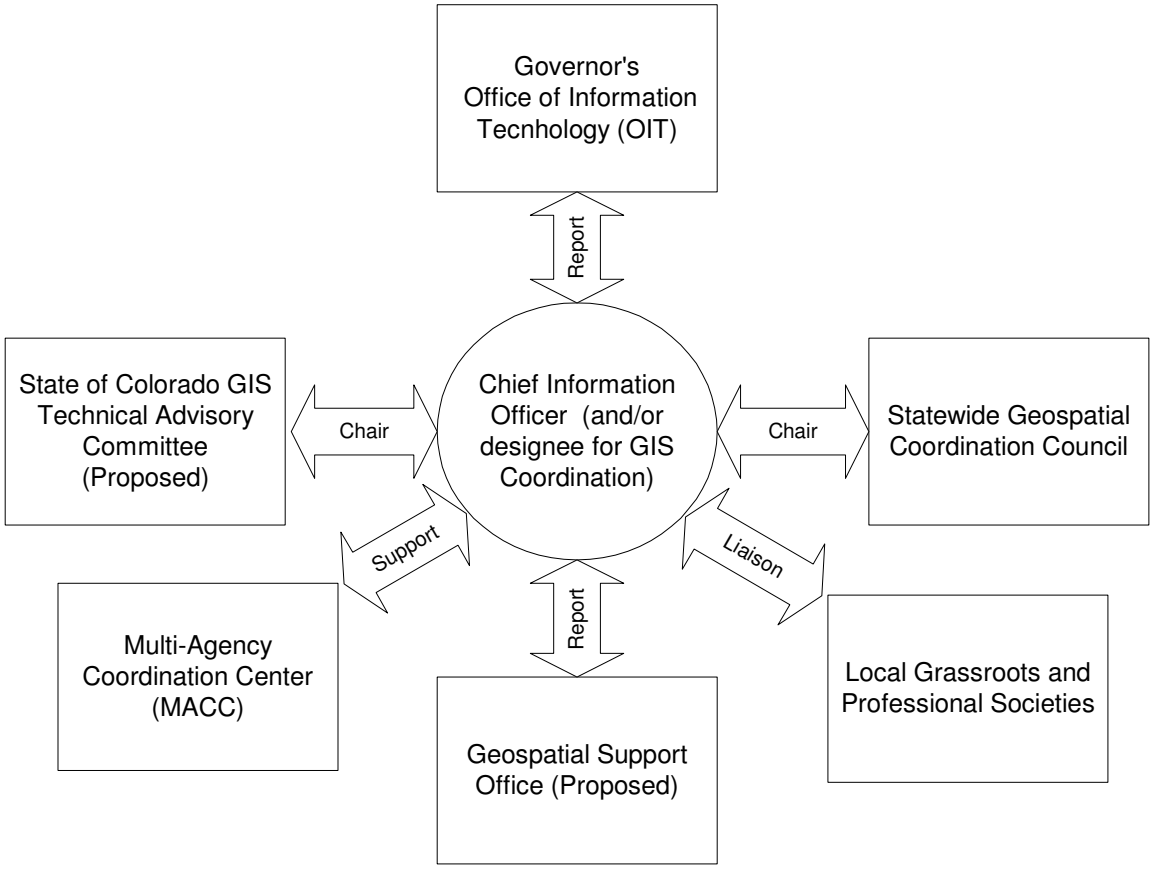
Water Conservation Board (CWCB), who is appointed by the Governor. In addition, members of CWCB include the departmental/divisional directors or commissioners for Natural Resources, Wildlife, and Agriculture; the State Engineer; the Attorney General; and the director of CWCB. This amounts to fifteen (15) members.

For the GIS case, fifteen (15) members for the statewide GCC should be adequate, if appointments are made from stakeholders around the state as well as from a subset of state agencies involved in GIS matters, both as producers and consumers of geospatial data. It is believed that an organizational approach modeled on IBCC has potential for greatly enhancing statewide GIS coordination and outreach, but this needs greater definition and discussion as an alternative to the existing approach (which is less geographically-oriented and more sector-oriented). Another geographic approach might be built around the state's Homeland Security Regions, of which there are nine (9) geographic areas.

Independent of whatever approach is used for formally organizing the statewide GCC, a state agency approach to organizing a GIS Technical Advisory Committee should be taken. The two would operate in concert, but with distinct purposes. This is explained in more detail, later in this section.

In addition, there is now a National Geospatial Advisory Committee (NGAC), which was announced by the Federal Geographic Data Committee (FGDC) in January of this year. FGDC is the financial sponsor of this Strategic Planning effort, as mentioned in the Foreword of this document. In the future, it is expected that the Colorado GCC will be in communication with NGAC in a manner that is beneficial to the state.

Conceptual Diagram of Coordination and Oversight Relationships




A State Agency GIS Technical Advisory Committee (GTAC)

The GTAC is envisioned to give technical input and advice to OIT, (via the CIO's GIS Coordinator) and can include the state agency appointees to the statewide GCC, as well as members invited by the CIO from the other agencies with GIS programs. Currently, this would amount to a total of approximately ten (10) members. The purpose of this committee should also be articulated in the Executive Order, including the facilitation of transformational change to support the goals expressed in this **GIS Coordination Strategic Plan**. Otherwise, progress toward an enterprise approach that is widely adopted and supported will not gain momentum, because the political mandate, roles, and responsibilities may not be clear.

A Geospatial Support Office

There are many actionable items in this plan that will not be addressed without resources. Expectations need to be calibrated to the level of commitment and support that is provided to the GIS Coordinator to actually execute on actionable items. It is recommended that the initial focus of this office be on building a geospatial data warehouse to support both statewide stakeholder needs and the requirements of the Multi-Agency Coordinating Center (MACC) for emergency response and homeland security, since both are highly correlated.

Local Outreach

The GIS Strategic Planning process has demonstrated the importance of local outreach through the five GIS Stakeholder Input Gathering Sessions around the state. It is a key part of nurturing a statewide geospatial Community of Interest (COI) and building a culture of data sharing. The IBCC roundtable model could be used to facilitate grassroots input on an ongoing basis. Potentially, a GIS representative could become integral to the IBCC roundtable membership, leveraging this structure beyond a normative model.

## 4.3 Budget Requirements

It is not expected that the full breadth of this plan will be funded from the get-go. Once a GIS Coordinator is in place within OIT, funding priorities for GIS investments need to be established, and these should be communicated before the next legislative budget cycle. The next Colorado fiscal year (FY 2009) begins July 1, 2008 and ends June 30, 2009.

The GIS Coordinator should communicate any new initiatives that might impact departmental budgets, independent of OIT expenditures, by summertime so that they can be factored into departmental budget proposals, which are submitted in late summer and early fall to the Office of State Planning and Budgeting. Some impacts may favorably reduce budget needs for unnecessarily duplicative efforts and infrastructure; and some impacts might shift budget needs toward support for specific coordination initiatives, as an outgrowth of this **GIS Coordination Strategic Plan**.

The OIT budget proposal should include a phased approach for establishing a Geospatial Support Office under the GIS Coordinator, with an initial priority on implementing a Geospatial Data Warehouse, for a modicum of authoritative data. Budget requirements for this purpose are projected to initially include three (3) full-time equivalent (FTE) positions, in addition to the GIS Coordinator.

By comparison, states with established programs equating to a Geospatial Support Office have made greater investments than the one initially contemplated for Colorado. For example, Utah established the Automated Geographic Reference Center (AGRC) in 1981. The AGRC is within the Division of Integrated Technology within the Department of Technology Services (DTS), under the office of the Chief Information Officer (CIO).

The AGRC is staffed by 16 FTE's and contractor support, including a GIS Manager, technology specialists, and data specialists in field data collection, raster/imagery, and thematic data layers such as transportation and boundaries. Under statutory authority, the AGRC administers the State Geographic Information Database (SGID) and provides GIS analysis, application development, training, and Internet Map Service development and hosting. AGRC facilitates activities that promote GIS across the state of Utah and coordinates GIS policy and implementation activities.

The Center has received a direct appropriation from state funding since 1984. AGRC is also authorized, through DTS, to set fees for its professional labor, data support, training, plotting, and GPS services. The FY07 base funding from the General fund for AGRC was approximately $900,000 and an additional $300,000 was appropriated from the E911 fund. With the addition of $500,000 generated from fee-services, and other state and federal grants and appropriations of approximately $500,000 (past examples include the Rural Government GIS Assistance Program and the program for digital orthoimagery), the annual operating budget of the AGRC is around $2.2 million. By comparison, the population of Utah is about 2.2 million people fewer than Colorado's (approximately 2.7 million to 4.9 million people), and the geographic area is about 20,000 square miles less than Colorado's (84,904 square miles to 104,100 square miles).

A more modest example is the Kansas Data Access and Support Center (DASC), which was established in 1991 as the State GIS Clearinghouse by the Kansas GIS Policy Board. The DASC is physically located at the Kansas Geologic Survey (KGS) at the University of Kansas, but operates under the direction of the Kansas GIS Director who is situated in the Kansas Division of Information Systems and Communications (DISC), and the GIS Policy Board. The DASC is currently staffed by a full time GIS Manager, a full time GIS Specialist, two part-time GIS Specialists, a Geodatabase Administrator/Web Application Developer, and a Portal Manager.

DASC provides GIS services to a wide Kansas GIS community, which includes the public, state agencies, local government, academic and non-profit institutions. These services include: GIS database development, archival and distribution, quality assurance/quality control (QA/QC); general technical assistance including geospatial metadata development assistance; data hosting and free data downloads via file and web services, web application development and hosting; and cartographic services. DASC also participates in coordination, education, and outreach activities to promote geospatial technology in Kansas.

DASC relies on baseline annual funding supplied by DISC (currently $250,000), operational support from KGS (access to office space, KGS vehicles, telecommunications, and IT infrastructure), and various fee-for-service activities. Overall, the DASC operational costs during FY07 are estimated to have been between $350,000 and $400,000. By comparison, the population of Kansas is about the same as Utah's, and therefore about 2.2 million people fewer than Colorado's (approximately 2.7 million to 4.9 million people), and the geographic area is about 22,000 square miles less than Colorado's (82,277 square miles to 104,100 square miles).

These two examples, the central GIS programs in Utah and Kansas, are not instead of departmental GIS programs, which continue to flourish in support of their mission requirements. Access to central resources have reduced duplication of effort, streamlined data acquisition, and allowed the states to more effectively apply geospatial data and technology to statewide needs.

# 5.0 IMPLEMENTATION TIMELINE

Colorado is behind many other states in implementing formal GIS Coordination and statewide geospatial data and infrastructure programs. A long-term approach is needed to correct deficiencies, and to take advantage of some of the inherent strengths within the state. In general terms, three major phases are envisioned, as follows:

- **Phase 1** *(2008-2010):* Governance, Budgeting, and Warehousing
- **Phase 2** *(2009-2011):* Implement Enterprise Architecture for Geospatial Requirements (Based on refactoring design subsequent to pilot project)
- **Phase 3** *(2011-2013):* Innovation and Application Refinement (Build applications to support stakeholder community based on statewide priorities and business processes)

Below is a table showing a set of key action items for **Phase 1** *(2008-2010)* of a long-term strategy to make Colorado the leader in the application of GIS, statewide.

| TIMELINE FOR PHASE 1 (A, B, & C) ACTION ITEMS | Phase 1A | Phase 1B (FY 2009) | | Phase 1C (FY 2010) | |
|---|---|---|---|---|---|
| | Jan-June 2008 | July-Dec 2008 | Jan-June 2009 | July-Dec 2009 | Jan-June 2010 |
| A. January 2008-June 2008 | | | | | |
| 1. *Establish the position of GIS Coordinator) in the Office of Information Technology (OIT)* | X | | | | |
| 2. *Develop budget for GIS support staff and accommodations* | X | | | | |
| 3. *Prioritize data needs for the Geospatial Data Warehouse* | X | | | | |
| 4. *Establish means for handling and sharing sensitive data* | X | | | | |
| 5. *Establish list of Authoritative Data and Sources* | X | | | | |
| 6. *Establish a formal charter and role for the Geospatial Coordinating Council* | X | | | | |

| | | | | | |
|---|---|---|---|---|---|
| B. July 2008-June 2009 | | | | | |
| 1. *Execute Memos of Understanding for data sharing* | | X | X | | |
| 2. *Get copies and catalog authoritative data from sources and establish Data Warehouse and establish repeatable ETL* | | X | X | | |
| 3. *Establish GIS Technical Advisory Committee from departmental representatives* | | X | X | | |
| 4. *Design Enterprise Architecture and Web services for Geospatial Data and Applications* | | X | X | | |
| 5. *Establish budget and scope for Enterprise Architecture initiative for geospatial requirements* | | X | X | | |
| 6. *Identify resources to harvest prioritized data* | | X | X | | |
| | | | | | |
| C. July 2009-June 2010 | | | | | |
| 1. *Get copies and catalog authoritative data from sources and establish Data Warehouse and establish repeatable ETL (continuation of prior phase)* | | | | X | X |
| 2. *Reconcile overlapping data sets from different authoritative sources* | | | | X | X |
| 3. *Perform only the QA/QC and ETL that is deemed essential to establish the Geospatial Data Warehouse* | | | | X | X |
| 4. *Facilitate access to the Warehouse via the GIS Portal and establish basic Web services* | | | | X | X |
| 5. *Determine if any new data creation is needed, and establish means for getting it done* | | | | X | X |
| 6. *Scope and conduct a pilot project on data sharing and output (maps and data products) as Proof-of-Concept for Enterprise Architecture* | | | | X | X |

# APPENDIX A. STRATEGIC PLANNING METHODOLOGY

For this effort, the State GIS Coordinator and the GIS Coordinating Council provided leadership, and a Working Group of volunteers provided specific input and review. Later in this section, both the Council membership and the Working Group membership are listed. An experienced GIS consultant, Applied Geographics, Inc. (AppGeo), was hired to facilitate the planning process, and to author the draft plan documents.

An important part of the planning process was to give a diversity of stakeholders the opportunity to provide input. For this purpose, a series of **Stakeholder Outreach Sessions** were conducted around the state, as follows:

- Grand Junction, October 2007
- Denver, November 2007
- Frisco, December 2007
- Durango, December 2007
- Pueblo, January 2008
- State agencies, Denver, January 2008

In addition, two relevant GIS studies were done for Colorado earlier in 2007, and these have provided valuable information to support the GIS strategic planning process. These studies were performed independently, in parallel to one another, but arrived at similar findings and recommendations. Applied Geographics, Inc. (AppGeo) performed one study, with support from Sanborn, to analyze GIS requirements in support of Emergency Management. CH2MHill undertook the other study, from the perspective of Information Technology (IT) requirements for Statewide GIS Coordination. This GIS Coordination Strategic Plan benefited from and built upon these previous efforts. Importantly, the state launched the "Colorado GIS Portal and Clearinghouse" in the fall of 2007, which was one of the recommendations made by both of the aforementioned studies. [See Appendix B for full references on these studies, and see http://coloradogis.nsm.du.edu to view the GIS Portal.]

**State GIS Coordinator:**
Jon Gottsegen

**State Geospatial Coordinating Council:**

| | |
|---|---|
| **Private**<br>Xcel Energy – Pete Gomez<br>CH2MHill – Brian Cullis<br>**Academic**<br>University of Colorado – Lynn Johnson<br>Colorado State University – Dave Theobald<br>**Federal**<br>USGS – Mark Eaton<br>FEMA – Doug Bausch<br>Census Bureau – Jim Castigneri<br>BLM – Ken Schauer<br>NOAA/NGS – Pam Fromhertz<br>**Municipal**<br>City of Fort Collins – Dan Coldiron<br>City of Aspen – Mary Lackner<br>Colorado Municipal League – Geoff Wilson | **County**<br>Mesa County – Rick Corsi<br>Pueblo County – Chris Markuson<br>Colorado Counties, Inc. – Chip Taylor<br>**Regional**<br>Denver Reg. Council of Gov'ts – Simon Montagu<br>**State**<br>Department of Transportation – Marv Koleis<br>Dept. of Natural Resources – Bill Martin<br>Dept. of Public Health and Env. – Mark Egbert<br>Dept. of Agriculture – Jon Langstaff<br>Dept. of Public Safety – Michael Nath<br>State GIS Coordinator/Dept. of Local Affairs – Jon Gottsegen |

| | |
|---|---|
| | **User Community**<br>GISColorado (DU) – Steve Hick<br>Rocky Mtn. URISA (Broomfield) – Karen Brandt |

**Working Group for GIS Strategic Plan:**

| Name | Affiliation |
|---|---|
| Paul Tessar | City and County of Denver |
| Steve Holmes | City of Loveland |
| Kathy Covert | FGDC (ret.) |
| Alyssa Martin | HDR, Inc. |
| Matt Gabriel | SpatialBiz |
| Eric Svensen | City of Montrose |
| Pete Magee | San Luis Valley GIS/GPS Authority |

# APPENDIX B. KEY REFERENCE DOCUMENTS

Applied Geographics, Inc., Sanborn, **Emergency Management GIS Application Needs Assessment and Architecture Design**, State of Colorado, Department of Local Affairs and Emergency Management, 30 May 2007.

CH2MHill, **Colorado Statewide GIS Coordination: Findings and Recommendations**, State of Colorado, Governor's Office of Information Technology, 10 August 2007.

# APPENDIX C. WGA POLICY RESOLUTION 06-14

**Western Governors' Association Policy Resolution 06-14 (13 June 2006)**

**Geospatial Data Is Part of the Nation's Critical Infrastructure**

## A. BACKGROUND

1. Geospatial data and Geographic Information Systems (GIS) technology have become indispensable tools for local, state, tribal and federal governments. Geospatial data, which is the digital representation of geographic features, including transportation, elevation, hydrology, boundaries, cadastre and imagery are essential for addressing critical issues facing western states.

Governments use these tools to improve services to citizens and to analyze, develop, and implement public policy related to public health, homeland security, transportation, hazards and wildfire response, energy development, land use, growth management, and many other business needs.

2. The National States Geographic Information Council (NSGIC) estimates that the geographic data required by state, local, regional, tribal and federal governments will cost in excess of $6.6 billion for initial collection, not including maintenance costs. Over 18,000 municipal governments, 3,141 county governments, unknown numbers of regional organizations, and over 327 tribal governments are all creating geospatial data in addition to the states and Federal government.

3. Coordination efforts between all sectors of government for data collection and maintenance needs to be dramatically improved. Otherwise, organizations will continue creating the same geospatial data over the same areas resulting in duplicate and sometimes conflicting data. There is potential for tremendous dollar savings as well as better decisions if accurate credible data was developed and shared through a coordinated approach.

4. A vital component of government geospatial information systems are land records and cadastral (or landownership) data. The Bureau of Land Management is working with state and local governments to develop standardized digital representations of the Public Land Survey System and parcel data to meet identified business needs such as forest health and wildland fire management, energy, and economic development. The result of this collaboration is called the Cadastral National Spatial Data Infrastructure (Cadastral NSDI). The Cadastral NSDI is critical for western states where land ownership is a patchwork of federal, state, tribal and private land parcels often with separated mineral ownership. The Common framework of landownership is essential to support many decisions and business processes in the west.

5. NSGIC, in cooperation with the Federal Geographic Data Committee, have developed the Fifty States Initiative which outlines a fundamental change in the way governments should work together to build a National Spatial Data Infrastructure (NSDI). It identifies the criteria which promote effective statewide GIS coordination activities and identifies characteristics of successful states, which can be used to establish statewide coordination councils that will take an active roll in completing a NSDI.

6. High resolution and current aerial and satellite imagery has become an essential commodity. Currently, imagery is being acquired by hundreds of different entities across the Nation. This leads to higher costs, varying quality and vintage, duplication of efforts and a patchwork of inconsistent and non-sharable products. Coordinating acquisition for large areas will lower the cost of imagery to the taxpayer and improve the availability of standardized, high-quality imagery products.

## B. GOVERNORS' POLICY STATEMENT

1. Western Governors urge BLM to complete, enhance, and maintain the Cadastral NSDI in coordination and partnership with states, tribal and local governments. Western Governors call on Congress to provide the necessary funding for BLM to undertake this important effort. Western Governors call on Congress to authorize the expenditure of already appropriated funding (i.e. Homeland Security) to create and maintain local, state and tribal implementation of the Cadastral NSDI in support of energy development, forest health restoration, wildland fire management, Homeland Security and First Responders.

2. Western Governors support large area data acquisition practices, as identified in NSGIC's Imagery for the Nation, which will keep the cost to the taxpayer as low as possible and improve the availability of standardized, high-quality imagery products. Imagery For The Nation is an important new initiative able to meet the Nation's needs, as well as the unique needs of Western States. Western Governors urge Congress to coordinate appropriations to existing federal imagery acquisition programs to fully fund the coordinated approach described in Imagery For The Nation.

3. Western Governors support federal, state, tribal and local coordination of GIS activities at the state level through state coordination councils. Western Governors applaud the results-oriented approach to building a National Spatial Data Infrastructure as outlined in the Fifty States Initiative.

4. Western Governors support federal initiatives including the implementation of the Federal Geographic Data Committee's Future Directions initiative and the development of the U. S. Office of Management and Budget's Geospatial Line of Business activity. These national efforts must include representation from state, local, and tribal governments.

5. Western Governors believe an intergovernmental approach to development and governance of geospatial activities is necessary to optimize investments and results. An intergovernmental governance approach for the NSDI ensures vital national interests as well as state and local government's business needs are served.

## C. GOVERNORS' MANAGEMENT DIRECTIVE

1. The Western Governors' Association (WGA) shall post this resolution to its Web site to be referred to and transmitted as necessary.

2. The Western Governors' directs the Western Governors' Geographic Information Council continue to support Western Governors' Association on geospatial data and technology issues.

# APPENDIX D. GIS STRATEGIC PLAN DOCUMENT HISTORY

| Version # | Date | Description | Responsible Party |
|---|---|---|---|
| 1.0 | 02/21/08 | Final Contractor Deliverable | AppGeo |
| | | | |

**NOTES:**